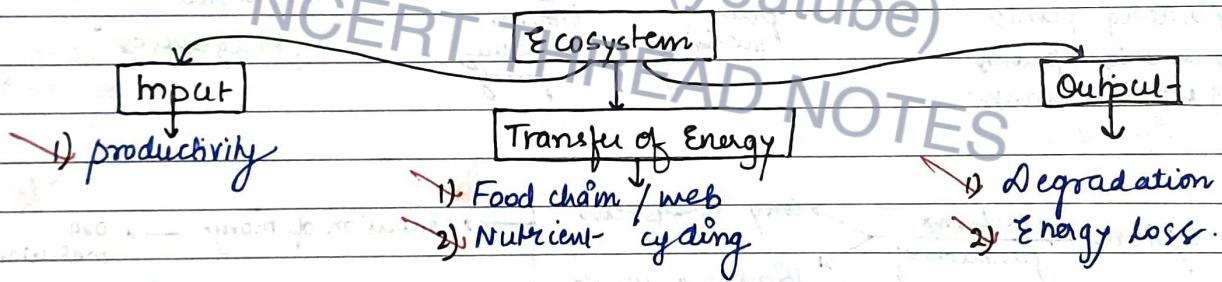
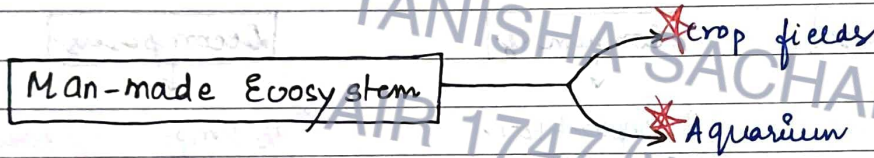
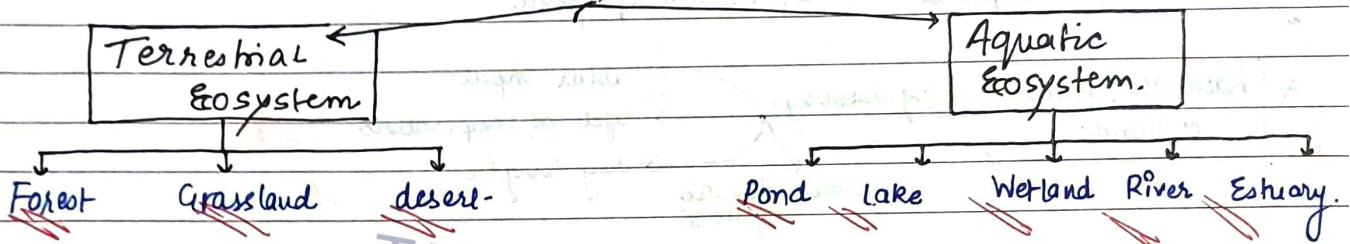


ECOSYSTEM

* Functional unit of Nature - Ecosystem ^{organism interact} among themselves with the surrounding physical environment.

Vary in size
From, small pond. to large forest or sea.

* Many ecologists regard (entire biosphere) as GLOBAL ECOSYSTEM.
(big too complex) → to be studied at one time, so



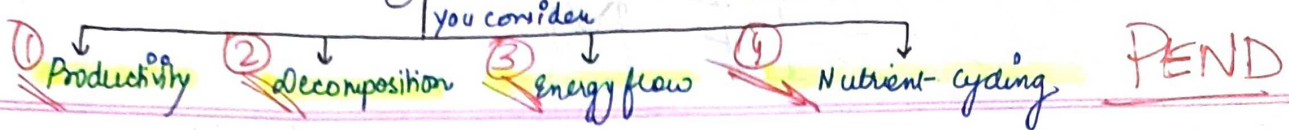
ECOSYSTEM - STRUCTURE & FUNCTION

* Components → abiotic & biotic
interaction of these result in physical structure. ^{that is characteristic for} Each type of ecosystem.

* Species Composition (of an ecosystem) is given by ^{identification} ^{Enumeration} of ^{plant species} ^{animal species}

* Stratification is Vertical distribution of different species occupying different levels.
Example: Layer of forests
trees - Top layer
Shrubs - 2nd Layer
herbs & grasses - Bottom layer

* Components of Ecosystem are seen to function as a unit when



* **POND** → self sustainable unit

explains even the complex interactions that exist in aquatic ecosystem.

shallow water body → in which all above 4 components well exhibited.

Abiotic factors

1 water → with dissolved inorganic subst. & organic subst.

2 rich soil deposits → at bottom of pond.

* **Rate of Function of pond**

regulated by

```

    graph LR
      A[regulated by] --> B[1 solar input]
      A --> C[2 cycle of temperature]
      A --> D[3 day length]
      A --> E[4 other climatic factors]
  
```

* **Autotrophic components**

- 1) phytoplankton.
- 2) Some algae
- 3) Floating plants
- 4) Submerged plants
- 5) Marginal plants
→ found at edges

Consumers

1) Zooplankton
↓
free swimming & bottom dwelling forms

Decomposers

- 1) Fungi
 - 2) Bacteria
 - 3) Flagellates
- especially abundant on bottom of pond

* This system performs function of

any ecosystem
Biosphere as a whole

→ consumption of inorg. → org. material
with help of Radiant energy of sun by autotrophs

1 decomposition
2 Mineralisation
→ consumption of autotrophy by heterotrophy

to release nutrients back for use of autotrophs
of dead matter

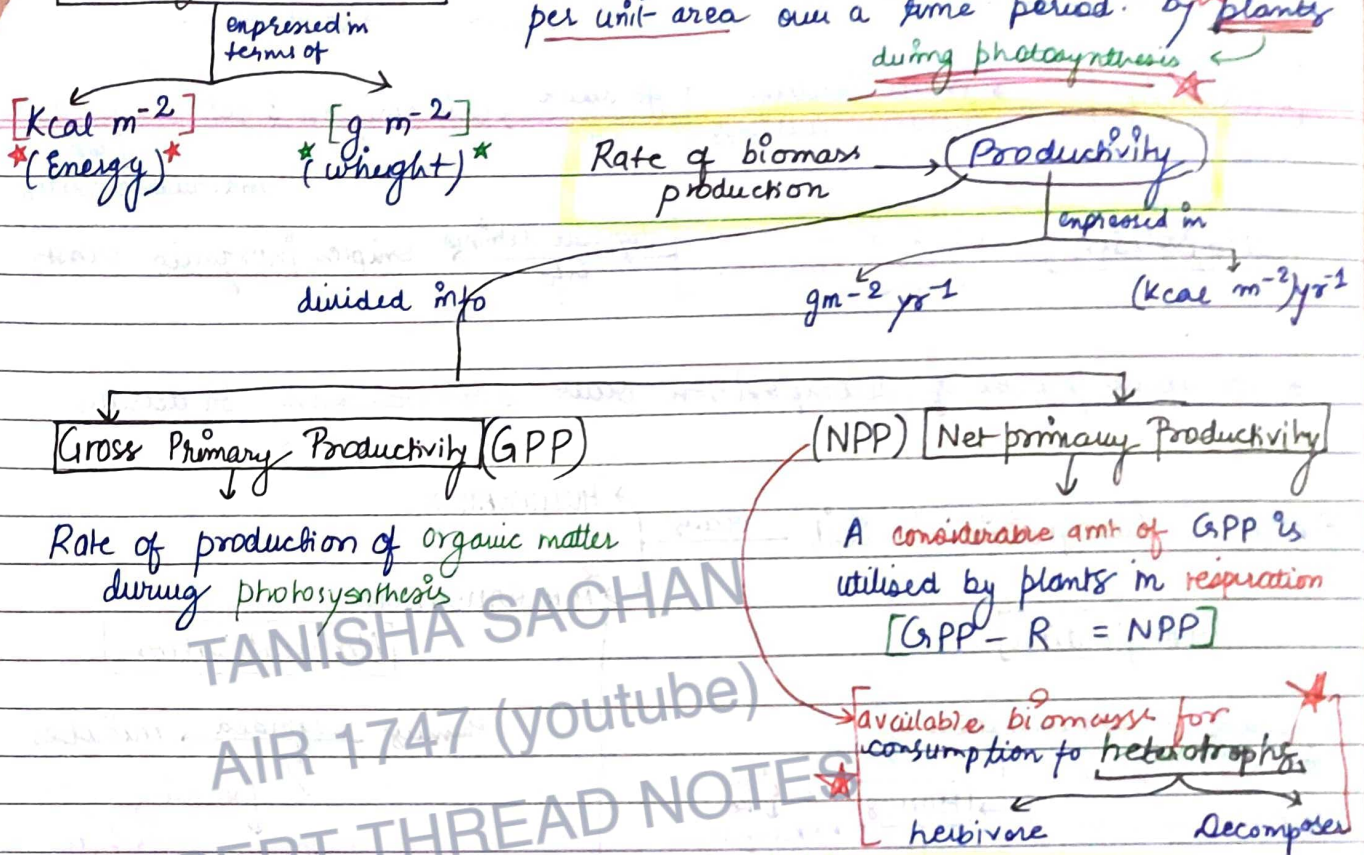
There is UNIDIRECTIONAL MOVEMENT OF 'ENERGY' towards higher trophic levels & its dissipation & loss as heat to environment

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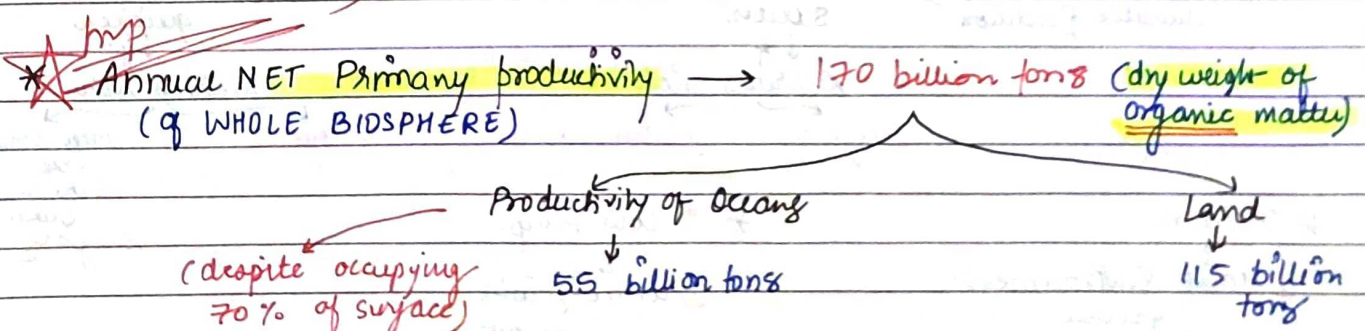
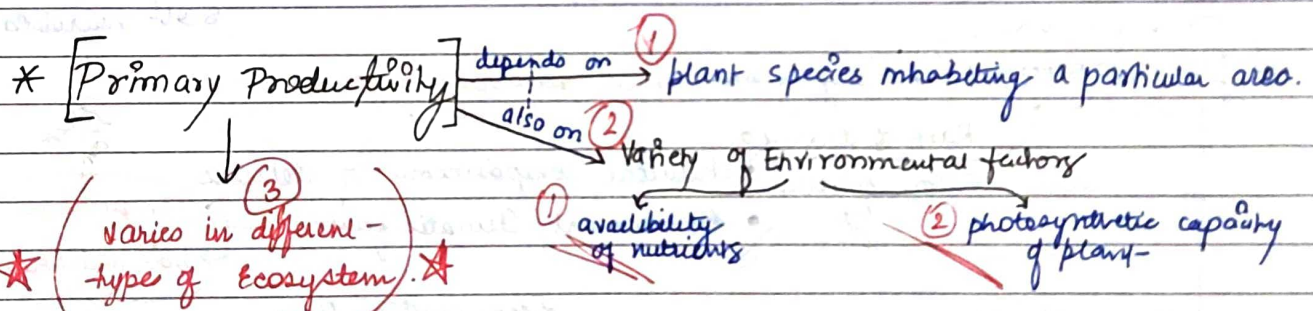
PRODUCTIVITY

* Basic requirement — constant input of solar energy
(for ecosystem to sustain function)

* **PRIMARY PRODUCTION** → Amt of biomass / organic matter produced per unit area over a time period by plants during photosynthesis



* **SECONDARY PRODUCTIVITY** → Rate of formation of new organic matter by CONSUMERS.



DECOMPOSITION

→ Earthworm - Farmer's friend

Decomposers break down complex organic matter into

① help in breakdown of complex organic matter

② loosening of soil

* **Detritus** → raw material for decomposition

→ dead remains of plants & animals (leaves, bark, twigs, fecal matter)

morganic substance like

CO₂ water nutrients

Fragmentation → Breakdown detritus into smaller particles
[detritivores] → earthworm.

Leaching → Water Soluble inorganic nutrients go down into soil horizon & get precipitated as unavailable salts

Catabolism → Bacterial enzymes / Fungal enzymes → degrade detritus into simpler inorganic subst.

* All above process of decomposition occur simultaneously on detritus

During decomposition in soil occurs → HUMIFICATION / MINERALISATION

Humification

Leads to accumulation of
* dark coloured
* Amorphous subst
→ HUMUS → colloidal so Reservoir of nutrients
* highly resistant to microbial action
(2) Decompose at an extremely slow rate

Mineralisation

Humus degraded by microbes releasing inorganic nutrients

* { DECOMPOSITION } → largely an oxygen requiring process.

Rate of decomposition controlled by chemical composition of detritus
• environment / climatic factors → Temperature / Soil moisture

in a particular climatic condition

Decomposition Rate

slower if detritus rich in lignin / chitin

quicker if detritus rich in nitrogen / water-soluble substance like sugars

* ① Warm
② Moist Environment
↓
favour decomposition

* ① Low temp.
② anaerobiosis
↓
inhibit decomposition

results in building up of organic material

ENERGY FLOW

Sun → only source of energy for ALL ecosystems [Except: Deep sea hydrothermal vents]

→ incident solar radiation

< 50%

PAR
(photosynthetically active radiation)

Plants capture 2-10% of PAR

this small amt of energy

We know

Plants

Photosynthetic Bacteria (autotrophs)

simple inorganic material

from Food

from sun's energy to make

sustains entire living world.

* All organisms dependent on for food → Producers either directly or indirectly

Unidirectional flow of ↓ energy from sun to producers

consumers. → then to

* Ecosystem ^{not exempt from} 2nd Law of thermodynamics

need → constant supply of energy to synthesise → molecules they require

↑↑ disorderliness → towards Universal tendency → to counteract

* Producers — green plants in ecosystem

Terrestrial ecosystem

- Herbaceous
 - Woody
- plants

Aquatic ecosystem

- phytoplankton
- Algae
- Higher plants

* Chain / Web of food → formed due to → interdependency

* No energy trapped into a org → remains in it forever

Energy trapped (by producer) → passed on to → consumer

or → organism dies

* death of org. starting of

Defines Food chain / Web.

* All animals — Consumers / Heterotrophs.

Primary Consumers (feed on producers)

→ HERBIVORE

Ex. Insects

Birds, Mammals in Terrestrial Eco.

★ Molluscs in Aquatic Eco.

Secondary Consumers

(Eat an animal which in turn eat plants)

Primary Carnivore (eat herbivores)

Tertiary Consumers

Secondary Carnivore

(Animals which depend on primary carnivore for food)

Simple Grazing Food Chain (GFC)

Grass (Producers) → Goat (Primary consumer) → Man (Secondary consumer)

Detritus Food Chain (DFC) ^① begins with ^② dead organic matter

made up of Decomposers (Heterotrophic organisms) also known as SAPROTROPHS to decompose

mainly Fungi and Bacteria they meet their energy requirement by degrading dead organic matter / Detritus

* Decomposers secrete digestive enzymes → break down → simple, inorganic material (dead & waste materials) → absorbed by them.

★ In Aquatic ecosystem major conduit for energy flow → GFC ★

★ In Terrestrial " " → DFC ★ rather than GFC.

* DFC can be connected to GFC (at some level) → Some org. of DFC are a prey to GFC animals. ★

make natural interconnections of food chain → Food Web

Cockroaches and Crows → Both are OMNIVORES.

In Natural Ecosystem

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* Organisms occupy a place in natural surrounding / community → accn to their → Feeding Relationship with other organisms.

★ Organisms occupy a specific place in food chain (TROPIC LEVEL) → based on → Source of nutrition / food.

* Amt. of energy ↓ decreases at successive trophic levels.

* When organisms die it is converted to Detritus / Dead biomass → serves as ENERGY SOURCE for decomposer.

* Organisms at each trophic level depend on those at lower trophic level → for energy demands

Standing Crop → Each trophic level has certain mass of "living material" at a particular time
 measured as ① Biomass (mass of living organism) OR ② Number in a unit area.

* Biomass of a species expressed in ~~fresh weight~~ **Dry weight** → more accurate

* No. of Trophic levels ~~restricted~~ as Transfer of energy follows **10% law**

Each Trophic level from lower one **transferred** only 10% of energy to

* In NATURE → it's possible to have so many levels
 • producer
 • herbivore
 • primary carnivore
 • secondary carnivore

ECOLOGICAL PYRAMIDS

plz see Diagrams in NCERT

gets similar shape whether you express ① food ② Energy relationship b/w organisms at different trophic levels

* Relationship expressed in terms of Number Biomass Energy

* Base of each pyramids — producers / 1st trophic level.

* Apex represents — Tertiary / Top level consumer.

* Given organism — may occupy more than one trophic level simultaneously

* Trophic level represents Functional level does not represent Species

* Species may occupy more than one trophic level in some ecosystem at same time.

Eg.

SPARROW → primary consumer — eats seeds, fruit, peas
 → secondary consumer — eats insects, worms

* In most Ecosystems → All pyramids of Number Energy Biomass → upright

* Energy at lower trophic level Higher level.

• producers > Herbivore
 (in both number & biomass)
 • Herbivore > Carnivore

★ Inverted pyramids

- of Biomass — in sea bcz Biomass of fish >> phyto plankton
- of Number — Tree ecosystem

* Pyramid of Energy — Always upright — bcz at next trophic level some energy always lost as heat.

Each bar in pyramids — amt of energy present at each trophic level in a given time or annually per unit area.

Certain Limitations in Ecological Pyramids

does not take into account — the same species belonging to 2 or more trophic levels

Assumes a simple food chain (something that never existed in nature) does not accommodate a food web.

Saprophytes are given not any place in ecological pyramids even though they play vital role in ecosystem.

ECOLOGICAL SUCCESSION

Important characteristic of Community → their structure & composition changes constantly

in response to changing environmental conditions.

★ This change is ① orderly & ② sequential

③ parallel with the changes in physical environment

These changes lead finally to Community — that is near equilibrium with environment

CLIMAX COMMUNITY

* Gradual & Fairly predictable change in the species composition of a given area

ECOLOGICAL SUCCESSION is called

* During succession → some species colonise an area & their population increases whereas population of other species decline & even disappear

more numerous become

* Entire sequence of communities that successively change in a given area.

SERE (S)

* Individual transitional communities termed as SERAL STAGES / SERAL COMMUNITIES

* In successive seral stages } there is
 a
 * change in diversity of species of organism
 * increase in no. of species & organisms
 * increase in Total biomass

* Present day communities (in world) is
 because of succession that occurred over millions of years
 since life started on earth

* Succession
 * Evolution } parallel process at that time

* Succession → starts in an area where no living organisms are there.

Primary Succession

* NO living org. ever existed

Eg - Bare rock
 Newly cooled lava
 Newly created pond/Reservoirs

* Establishment of new biotic community
 is GENERALLY SLOW.

soil ← before this is established there should be

* Depending mostly on climate
 ↓ it takes natural process
 100 - 100's yrs to produce FERTILE SOIL on Bare Rock.

Secondary succession

* Area that somehow lost all the org. that existed there.

Eg - Abandoned farm lands
 Burned forests
 Cut forest
 Lands have been flooded.

* In areas, where natural biotic communities have been destroyed.

* Since some ^① soil / ^② sediment present
 ↓
faster than primary succession

* Description of ecological succession usually focuses on change in vegetation.

Various types of animals. for food shelter these vegetational changes in turn affect
 succession proceeds → number of types of animals decomposers } also change

* At any time during primary / secondary succession } Natural disturbance
 Human induced disturbance

* Such disturbances create new conditions that
 encourage some species
 discourage / eliminate other species

Earlier Stage in Particular Seral Stage of succession
 (fire, deforestation) can convert

Succession of Plants

Based on Nature of Habitat

In wet areas →

(hydric → mesic)

Hydrarch ~~Succession~~

In dry areas →

Xerarch succession

(xeric → mesic)

Mesic

• medium water condition

• neither too dry, nor too wet

* Species invading bare area - Pioneer species

* Primary succession on rocks -

Lichens

→ secrete acid to dissolve rocks.

these pave way to

help in weathering & soil formation

able to take hold in small amount of soil.

BRYOPHYTES

(very small plants)

succeeded by

Higher plants

after several more stages

Stable Climax Forest Community is formed

"Climax community remains stable as long as environment remains unchanged."

* With time, Xerophytic habitat gets converted into Mesophytic one.

PRIMARY SUCCESSION IN WATER

Pioneers - small phytoplanktons

↓ replaced by

Rooted submerged plants.

Marsh meadow

← Reed Swamp

Free floating plants.

← Rooted floating angiosperms

↓ scrub

→ Finally trees.

* Climax - Forest

* With time water body converted into land.

SECONDARY SUCCESSION

→ species that invade depends on

↓ Soil is here

→ rate of succession much faster

↓ hence climax reached more quickly.

- condition of the soil
- availability of water
- environment
- seeds/propagules present.

- ★ Primary succession → very slow process.
 → takes thousands of years for climax to be reached.

- ★ All succession whether taking place on → Land → proceeds to similar climax community
 → Water
- living org. → rocks, air, water
 ↓
 (BIOGEOCHEMICAL CYCLES)
 ↓
 MESIC.

NUTRIENT CYCLING → storage movement of nutrient elements through various components of ecosystem.

Organisms need constant supply of nutrients to → grow
 → reproduce
 → regulate various body function

STANDING STATE — The amount of nutrients (C, N, P, Ca etc...) present in soil at a given time.

varies in
 ↓
 different kinds of ecosystem on seasonal basis

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- ★ Nutrients never lost from ecosystem → recycled time & again indefinitely.

Gaseous cycle

Nitrogen, Carbon

Reservoir - atmosphere

Sedimentary cycle

Sulphur, Phosphorus

Reservoir - ~~sedimentary~~ Earth's crust

Function of Reservoir - to meet with deficit which occurs due to imbalance in rate of influx & efflux.

Teacher's Signature.....

Environmental factors

- Soil
- Moisture
- pH
- Temperature

} regulate the rate of release of nutrients into the atmosphere.

ECOSYSTEM - Carbon Cycle

→ occurs through

- atmosphere
- Ocean
- Living & dead org.

'C' constitutes 49% of dry weight - of organisms
→ next to water

Reservoir that regulates amount of C in atmosphere

Total Global Carbon

- 71% 'C' - dissolved in OCEANS
- 1% 'C' - in atmosphere.

Fossil fuels - also Reservoir of Carbon.

★ 4×10^{13} kg carbon is fixed annually in biosphere through photosynthesis

★ Considerable amount of carbon returns to atmosphere as CO_2 through - respiratory activities of producers & consumers.

★ Decomposers - contribute substantially to CO_2 pool by processing of - waste materials & dead organic matter of land or oceans.

★ Some amount of fixed carbon is LOST TO SEDIMENTS & removed from circulation.

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Additional sources for releasing CO_2 in the atmosphere

- Burning of Wood
→ Forest fires
- Combustion of Organic matter
→ Fossil fuels
- Volcanic activity

Human Activities have significantly influenced Carbon cycle.

- Rapid Deforestation
- Massive burning of fossil fuel (for energy Transport)

} → ↑↑ rate of release of CO_2 into atmosphere.

ECOSYSTEM - Phosphorus Cycle

Many animals need it
(large quantities) of 'P' to
make shells
Bones
Teeth.

major constituents of
→ Biological membranes
→ Nucleic acid
→ Cellular energy Transfer system

★ Natural Reservoir of P - Rock (contains 'P' as phosphates)

When weathered minute quantity
of phosphate dissolve in soil
solution & ^{is} absorbed by the roots

★ Herbivore & other animals get 'P' from → Plants

★ Waste products
Dead organisms] decomposed by → phosphate-solubilising bacteria
releasing PHOSPHORUS.

★ Unlike 'C' cycle, no respiratory release of 'P' in atmosphere.

⊗ 2 Differences b/w Carbon & Phosphorus Cycle:

- 1) Atmospheric inputs of phosphorus through rainfall is <<< than Carbon inputs.
- 2) Gaseous exchanges of phosphorus b/w organisms & environment are negligible.

Teacher's Signature.....

ECOSYSTEM SERVICES

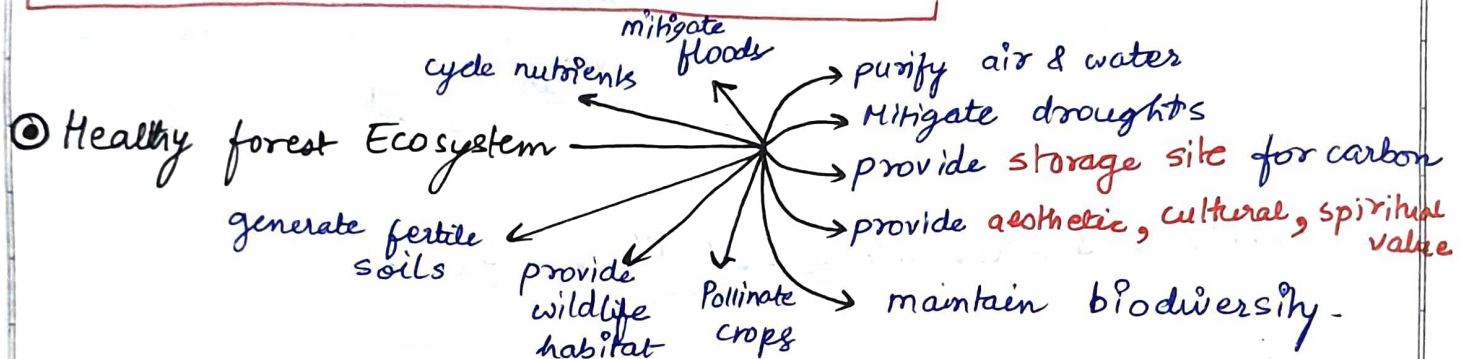
Healthy ecosystem

base
for

wide range of economic
environmental
Aesthetic

goods &
services

Products of ecosystem process] named as Ecosystem Services



Value of such services difficult to determine

Biodiversity should carry a hefty price tag

* ROBERT CONSTANZA & his colleagues → very recently tried to put price tags on Nature's life supporting services

* Researchers have put Avg. price tag of US \$ 33 trillion / a year on fundamental ecosystem services.

nearly twice the value of the global GNP (gross national product) → US \$ 18 trillion.

but are taken for granted bcz they have free.

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★ Out of the total cost of various ecosystem services :

1) Soil formation accounts for 50 %.

2) Recreation
Nutrient Cycling } → are less than 10% each

3) Climate Regulation
Habitat for Wildlife } → about 6% each

New

→ Few Points from SUMMARY :

1) Atmosphere Or Hydrosphere is reservoir for gaseous type of cycle (carbon)

★ 2) Biotic community — Dynamic
undergoes (changes) with the passage of time

↓
are sequentially ordered
↓ constitute
ecological succession